Annals of the Sri Lanka Department of Agriculture, 2002. 4: 109-117

INFLUENCE OF POTASSIUM FERTILIZATION ON GROWTH AND YIELD OF EMBUL BANANA (*Musa* spp. AAB GROUP) GROWN IN RHODUDALFS UNDER IRRIGATED CONDITIONS

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ABSTRACT

Banana is a very popular fruit crop grown extensively in the southern dry zone of Sri Lanka. Compared to most of the other crops grown in the region, banana plant has a very high demand for potassium. In order to assess the effect of the addition of potassium in *Rhodudalfs* an experiment was conducted at the Grain Legume and Oil crops Research and Development Centre, Angunakolapelessa from 1998 to 2000 for *Embul* banana (*cv Mysoor*). Response to the addition of potassium was shown from the mother crop to the second ratoon crop. Potassium had affected fruit characters as well as the fruit yield of Embul banana. Addition of potassium up to 240 g K_2O/clump increased the yield significantly. The total yield increase over a three-crop cycle was from 36.5 kg/clump to 52.5 kg/clump. The effect of potassium addition was more pronounced in the ratoon crop than that of the mother crop. A depletion of exchangeable potassium content was observed with the lower levels of potassium addition in the first 20 cm of the soil during the three-crop cycle.

KEY WORDS: Banana, Potassium, Exchangeable Potassium, Rhodudalfs

INTRODUCTION

Banana is a very popular fruit crop grown in the southern dry zone of Sri Lanka. It had been estimated that more than 13% of the total banana extent in Sri Lanka is in this region. (S.S. Weerasinghe, personal communication). The crop is mainly grown on the Reddish Brown Earths (Rhodudalfs) with varying drainage classes. According to Lahave (1995) banana removes more potassium (K) than any other nutrient from the soil and this amount is nearly thrice of Nitrogen. Although many studies have been conducted on the role of K on banana in other countries, evidence on the effects of K fertilization on banana is very rare in Sri Lanka. Padmasiri and Jinadasa (1992) have reported the response of banana to the application of K in Ultisols under supplementary irrigation. This study was undertaken to investigate the influence of K on the growth and yield of dessert banana grown in Rhodudalfs under irrigated conditions.

MATERIALS AND METHODS

A field experiment was established under irrigated conditions at the Grain Legume and Oil seed Crops Research and Development Center, Angunakolapelessa of the DL_1 agro-climatic region using Embul banana (Mysoor, AAB group). Soil to the depth of 20 cm at the site was sandy clay loam having pH (1:1 water) of 6.2, electrical conductivity of 0.01 dS/M, Olsen P content of 3.0 ppm and exchangeable K content of 134.4 ppm. Organic matter content of the soil was 1.4%.

Banana suckers of nearly 2.5 - 3 month old were planted in pits of unattended soil at 3 m x 3 m spacing. In order to obtain a uniform crop all the established plants were decapitated to facilitate the emergence of suckers two weeks after the establishment. Three suckers were initially allowed to grow and after three weeks two suckers were removed leaving one sucker. Fertilizer treatments were assigned at this stage and this crop was considered as the mother crop of the plantation. Five levels of K namely 0, 60, 120, 180, and 240 g of K_2O/clump were applied to single tree plots. Four border trees surrounded each single tree plot and each treatment was replicated four times. Nitrogen for all the trees were applied at the rate of 110 g N/clump and P at the rate of 60 g P_2O_5/clump. Fertilizer applications were repeated in the same manner in every four months until the experiment was terminated after the 2nd ratoon. Sucker management and other cultural practices were done according the Department of Agriculture (DOA) recommendations. Surface irrigation was practiced in two weeks interval.

Plant girth was measured at 30 cm above the base of the clump at the harvest. Bunch weight was recorded after cutting the stalk 25 cm away from the first hand and 10 cm away from the last hand. Number of hands per bunch was counted in every harvested bunch and number of fingers per bunch was calculated based on the number of fingers in three hands from top, middle and bottom (2nd, 5th and the hand prior to the last) of the bunch. Length and diameter of the fruits were measured and fruit weights were recorded using three fruits from each of hands mentioned.

Soil samples were taken from 0 - 20 cm and 20 - 40 cm depths using a gauge auger before the commencement and at the end of the experiment. Samples were taken from the manuring circle of the plants that extends nearly to a 60 cm radius from the base. Soil analysis was performed according to the standard procedures followed by the DOA. Data were analyzed using the MSTAT statistical package.

RESULTS AND DISCUSSION

Crop performances

Growth performances of the plants did not show a remarkable change due to the application of K from mother crop to the 2nd ratoon (Table 1). None of the plants showed clearly visible K deficiency symptoms due to the non-addition of K. Lahave (1972) observed visual symptoms of K deficiency at very late stage in sand culture studies. Warner and Fox (1977) showed that heavy fertilization was needed to maintain leaf K content above the critical level though only few indications of K deficiency appeared. Table 1 shows the effect of K on the leaf number and plant height at flowering. Abu Hassan and Chattopadhyay (2000) reported significant increase in psuedostem height and number of leaves due to K fertilization in Cavendish banana (AAA Group).

Table 1. Influence of potassium on the plant height and the number leaves produced at flowering in the three- crop cycle

K_2Og/ clump	*Plant Height (m)*			*No Leaves*		
	Mother	*Ratoon 1*	*Ratoon 2*	*Mother*	*Ratoon 1*	*Ratoon 2*
0	2.31	3.00	2.77	38.5	32.0	30.5
60	2.25	2.99	3.21	35.5	26.5	32.0
120	2.42	3.07	2.95	33.0	29.3	32.5
180	2.29	2.96	3.12	36.5	28.5	26.5
240	2.39	3.15	3.08	37.6	29.5	31.0

Analysis of variance

Source of Variation	*Mean Square*	*Source of Variation*	*Mean Square*
Crop	26.46**	Crop	214.5**
Potassium	1.055 ns	Potassium	35.62 ns
CV%	8.58	CV%	18.6
SED (df = 9) Crop	0.51	SED (df = 9) Crop	4.63

** - significant at 1% level, ns – not significant

Although variations could be observed between crops, according to Table 1, K alone had no effect on the psuedostem height and the number of leaves produced (Table 1). This might be due to the supply of sufficient potassium from the soil to maintain the pseudostem height and the leaf production of the crop. Lahave (1989) reported that longevity of the leaves was reduced in sand culture due to deficiency of K. Potassium starvation had reduced the psuedostem height in sand culture experiments (Lahave, 1972).

Figure 1 shows the effect of K on plant girth. Addition of K increased the plant girth at all three cycles. However, effect was much pronounced in the ratoon crops. This indicates that the supply of potassium helps to produce stronger plants. Lahave (1972) also reported the reduction in plant girth due to starvation of K in sand culture. Abu Hassan and Chattopadhyay (2000) also observed significant increase in plant girth due to K addition under filed conditions in AAA group banana.

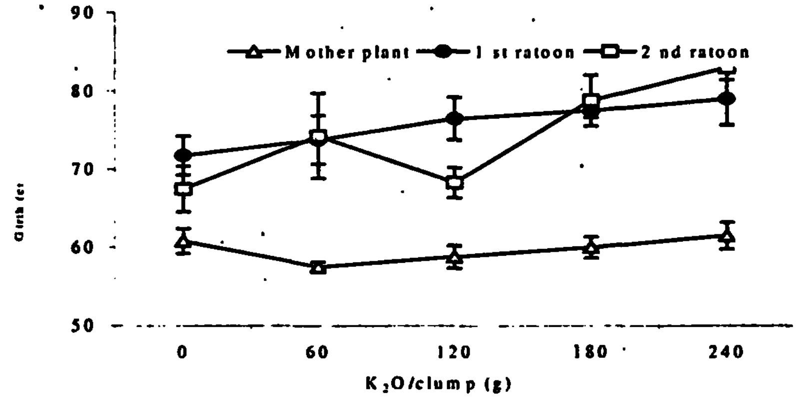

Figure 1. Influence on plant girth due to the application of potassium in *Embul* Banana

Bunch and fruit characteristics

Results revealed that both the number of hands and the number of fingers significantly increased by K fertilization (Table 2). Increase in number of fingers was much prominent in the 1st and 2nd ratoon of the crop. This increase was 14% and 18% for the mother crop and the 1st ratoon respectively, when compared with the no potassium treatment with the highest level of K treatment.

Table 2. Number of hands and the number of fingers per bunch as affected by the application of potassium for embul banana

K_2Og/ clump	*No Hands/bunch*			*No Fingers/ bunch*		
	Mother	*Ratoon 1*	*Ratoon 2*	*Mother*	*Ratoon 1*	*Ratoon 2*
0	8.8	10.8	8.3	132.9	180.7	131.3
60	8.8	10.8	11.0	137.3	172.5	167.7
120	8.8	10.8	10.0	160.7	183.6	148.9
180	9.3	11.3	10.3	151.1	204.3	174.9
240	9.3	11.8	11.3	150.1	212.5	201.0

Analysis of variance

Source of Variation	*Mean Square*	*Source of Variation*	*Mean Square*
Crop	22.200**	Crop	9903.03**
Potassium	6.239**	Potassium	2842.46**
SED K_2O (df = 36)	0.80	SED K_2O (df = 36)	21.78
SED Crop (df = 9)	1.49	SED Crop (df = 9)	31.46
CV%	7.65	CV%	12.88

** significant at 1% level

When the same two treatments were compared there was an 87% increase of number of fingers in the 2nd ratoon indicating that long-term non-addition of K could lead to serious draw back in fruit development. Abu Hassan and Chattopadhyay (2000) too showed similar results with regard to K on number of hands and number of fingers under field conditions.

Table 3 shows the influence of K in Rhodudalfs on fruit size of Embul banana. According to Table 3, fruit length and diameter had not been affected considerably due to the addition of K in the mother crop. However effects can be observed in the first and second ratoon especially with regard to fruit diameters. Abu Hassan and Chattopadhyay (2000) observed significant increase in fruit length and diameter by K fertilization.

Table 3. Fruit length and diameter of Embul banana as affected by the application of potassium

K_2O g/ clump	Fruit Length cm			Fruit Diameter cm		
	Mother	Ratoon 1	Ratoon 2	Mother	Ratoon 1	Ratoon 2
0	10.6	12.3	10.6	3.4	3.5	3.3
60	9.5	12.1	10.7	3.6	3.6	3.1
120	11.5	12.1	11.4	3.6	3.6	3.7
180	11.1	12.8	9.0	3.8	3.8	3.5
240	10.6	11.6	10.0	3.5	3.4	3.7

Analysis of variance

Source of Variation	Mean Square	Source of Variation	Mean Square
Crop	16.60**	Crop	0.09ns
Potassium	3.56ns	Potassium	0.16ns
SED Crop (df = 9)	1.29	SED Crop (df = 9)	0.10
CV%	11.7	CV%	10.2

** significant at 1%. ns – not significant

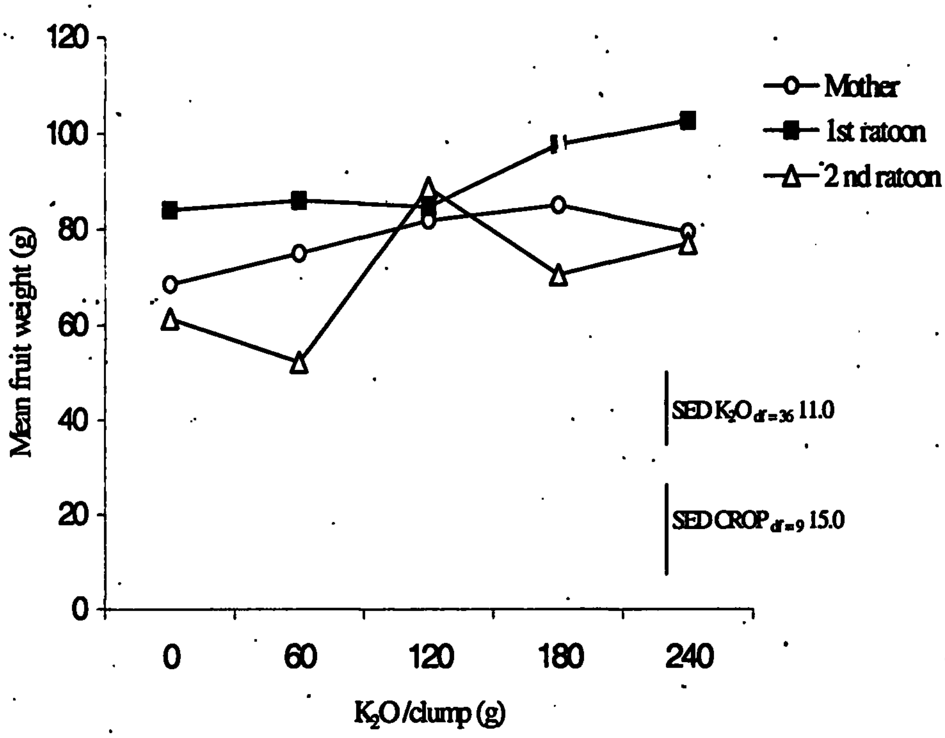

Figure 2. Influence of potassium fertilization on the fruit weight of Embul Banana

Potassium fertilization has significantly affected the fruit weight in all three crops (Figure 2). According to Figure 2, increase in fruit weight was observed with the increase in the level of K for all three crops. The increase in weight could be the result of increase in size as shown earlier and also due to the better filling of fruit.

Crop yield

Addition of K has significantly increased the bunch weight of the Embul banana in all the crops in this experiment (Figure 3) and this increase was much grater in the ratoons compared to the mother crop. For the mother crop increase in bunch weight was from 10.7 kg to 13.0 kg and for the 1st ratoon it was from 16.5 kg to 22.6 kg (Figure 3). Yield increase in the second ratoon was from 9.3 kg to 17.2 kg. Thus the total increase in bunch weight was 36.5 kg per clump to 52.5 kg per clump during the three-crop cycle.

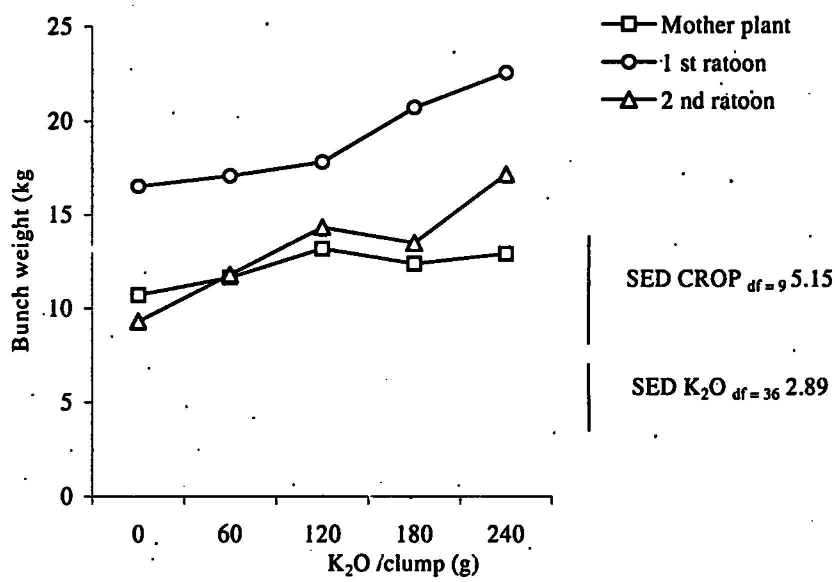

Figure 3. Effect of potassium fertilization on the bunch weight of embul banana in three crop cycles

Hence the increase in yield was 35.6% for the 1st ratoon and 84.6% for the 2nd ratoon while the increase in bunch weight was around 20% for the mother crop. Padmasiri and Jinadasa (1992) also observed response to the application of K in Ultisols under supplementary irrigated condition. However they had monitored the performances of only one crop. Increase in crop yield of banana due to the addition of potassium was reported by many authors (Garcia *et al,* 1972, Turner and Barkus, 1982, Mustaffa, 1988; Sheela and Aravindakshan, 1990; Abu Hassan and Chattopadhyay, 2000).

As shown previously the increase in bunch weight may be mainly due to the increase in number of fingers and also the finger weight. For the mother crop however, yield plateau has attained in this experiment beyond 120 g K_2O/clump where as the yield increase showed significant linear relationship (Table 4) with the 1st ratoon and the 2nd ratoon.

Table 4. Relationship of bunch weight and the level of potassium addition

Crop	*Relationship*	*Correlation co-efficient*
Mother	Y = 11.15 + 0.008 X	0.81 ns
1st ratoon	Y = 15.795 + 0.026 X	0.96**
2nd ratoon	Y = 9.74 + 0.029 X	0.94*

ns – not significant, * -- significant at 5% level, **-- significant at 1% level.
Y – Bunch weight kg, X – K_2O g/clump

Soil potassium

There was a decline in exchangeable soil K content after the three-crop cycle in the first 20 cm of the soil when no fertilizer potassium was applied. However, no such depletion could be observed at 20 - 40 cm depth with the same treatment (Figures 4a and b).

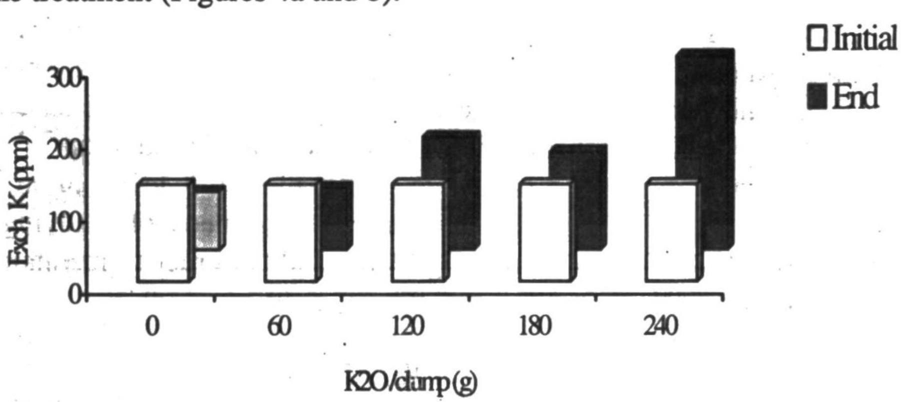

Figure 4a. Change in exchangeable potassium content of the 0 - 20 cm soil layer.

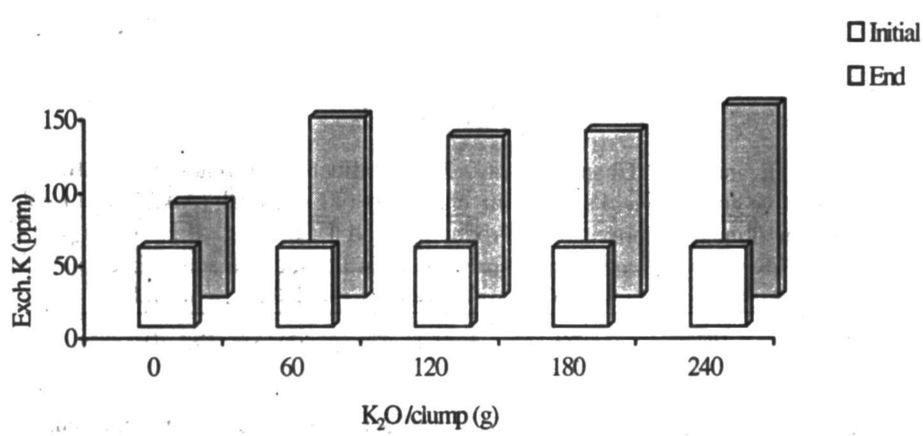

Figure 4b. Changes in exchangeable potassium content of the 20 – 40 cm soil layer

Soil analysis further revealed that from the K application level of 60 g K_2O/clump, there is a build up of soil exchangeable K in the 20 - 40 cm layer of the soil. However such a build up was clear at 0 - 20 cm depth only with the addition of 120 g K_2O/clump (Figure 4b). The build up of K in the deeper layer may indicate the movement of K fertilizers due to leaching. The non-build up of exchangeable K at 60 K_2O g/clump level indicates the depletion of K from the soil even at this rate of addition. It is not clear the reasons for the continuous increase in soil exchangeable K beyond the level of 120 g K_2O/clump, when the crop is responding to the application. Perhaps it could be due to depletion of soil K level when the crop is in real demand of this nutrient. Higher soil test values obtained at the end of the experiment could be due to the replenishment from the potassium pool in soil at the end of the experiment. This aspect however needs to be studied further before arriving at a definite conclusion. This behavior in addition indicates that the critical soil K level for Banana in this soil could be much higher than that of 300 ppm of exchangeable K for this soil. According to Delvauxe (1995) the critical soil K value is around 600 ppm of exchangeable K for many soils.

CONCLUSIONS

Embul banana responds well to addition of K fertilizers under irrigated conditions in Rhodudalfs. Application of K fertilizer increased the number of fingers /hand and bunch and also the fruit weight. Thereby it increased the bunch weight. The depletion of soil K indicated that the addition of K is extremely important in growing banana to sustain the soil K levels in order to obtain higher yields. These results further show the need of studying the behavior of soil K in different Banana growing soils in order to maintain the long-term productivity.

ACKNOWLEDGEMENT

Authors wish to thank the Additional Director, Mr L.A. Weerasena of the Grain Legume and Oil seed Crops Research and Development Centre for his continuous guidance and the support given throughout the study.

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